THE UNIVERSITY of MANCHESTER

Introductory AVS Course

Student Workbook

ADVISORY GROUP ON Computer Graphics

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Manchester and North HPC T&EC

MAN T&EC

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Document Editor

The original document was compiled and typeset by Steve Larkin, Computer Graphics Unit, Manchester Computing Centre using the document preparation system LaTeX.

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1 Introduction

The Introductory AVS Course

The Introductory AVS Course has been developed by the Manchester and North High Performance Computing Training and Education Centre (MAN T&EC), and is based on an earlier version produced by Manchester Computing Centre (MCC) for the UK Advisory Group on Computer Graphics (AGOCG).

The Application Visualisation System (AVS) is a system which allows users to visualise their data by constructing applications from a series of software components called modules. The course is aimed at those who have a need to visualise both 2D and 3D data, techniques covered include: reading data, creating 2D images, isosurfaces, arrow plots etc. The course is designed for the user with no prior experience of AVS. No programming is required but some basic experience of working in a workstation environment (unix and X windows) is needed.

This document contains all the practical exercises and solutions for the Introductory AVS Course.

Before starting the exercises

Some data files for these exercises are not part of the standard AVS release and the introductory course assumes they have been made available under the directory `/usr/avs/auxdata`. Copies of these data files can be obtained via anonymous FTP from the University of Manchester (ftp.mcc.ac.uk or IP address 130.88.203.12, `pub/mantec/avs/intro.tar.Z`). The answers to the exercises in chapter 3 and 4 can be found in appendix A.

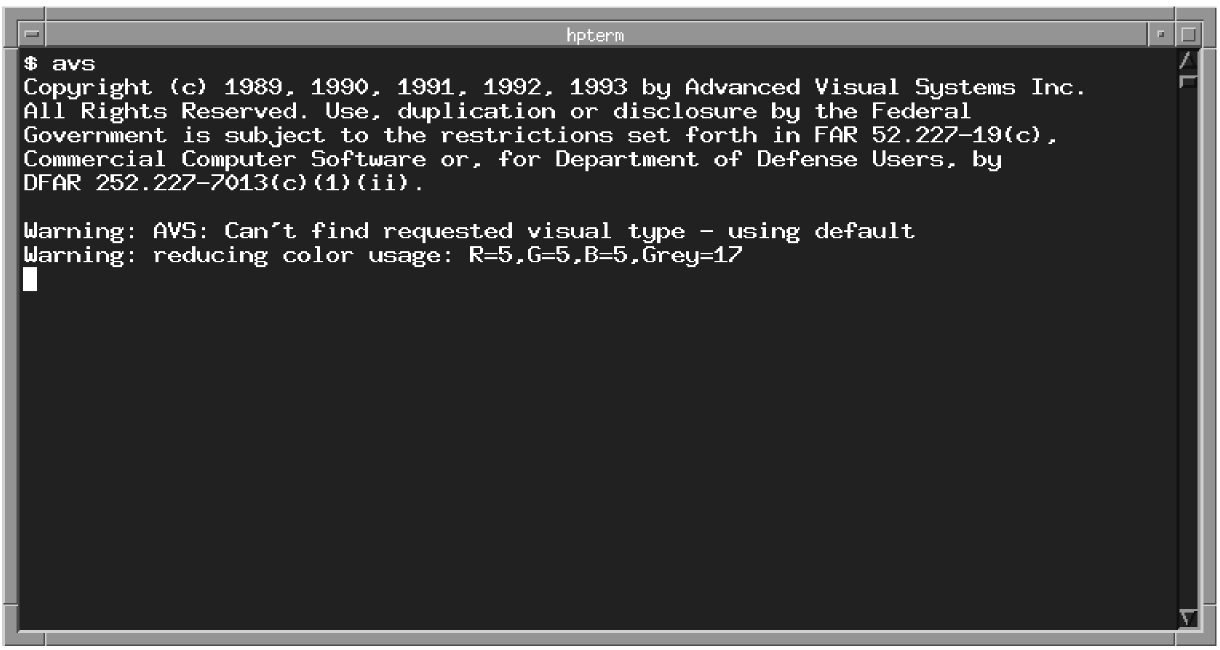
You may now proceed with the examples detailed in this workbook.

2 Using the network editor

Aims of this exercise

This exercise will illustrate the general features of the AVS network editor including the construction and manipulation of applications. The exercise uses standard AVS and no auxiliary data files.

Starting AVS



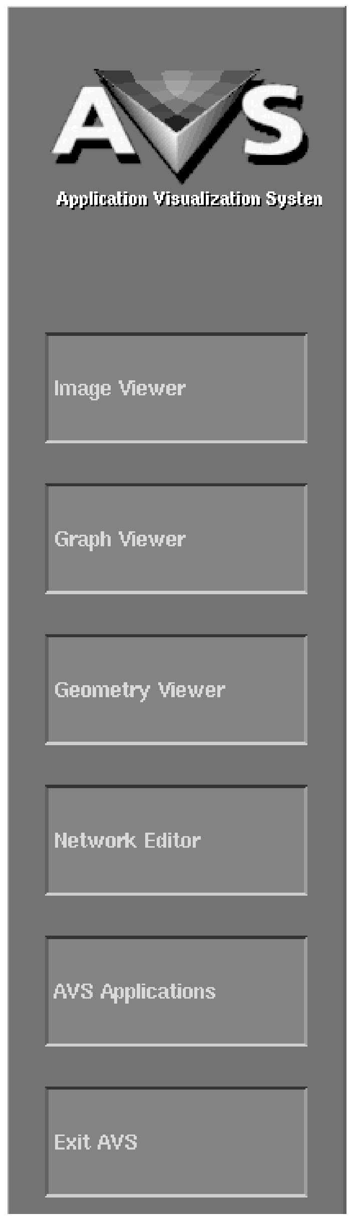
Starting AVS

To start AVS simply type the following command:

```
avs
```

A copyright notice will signify that AVS is starting up and the AVS main menu will appear shortly.

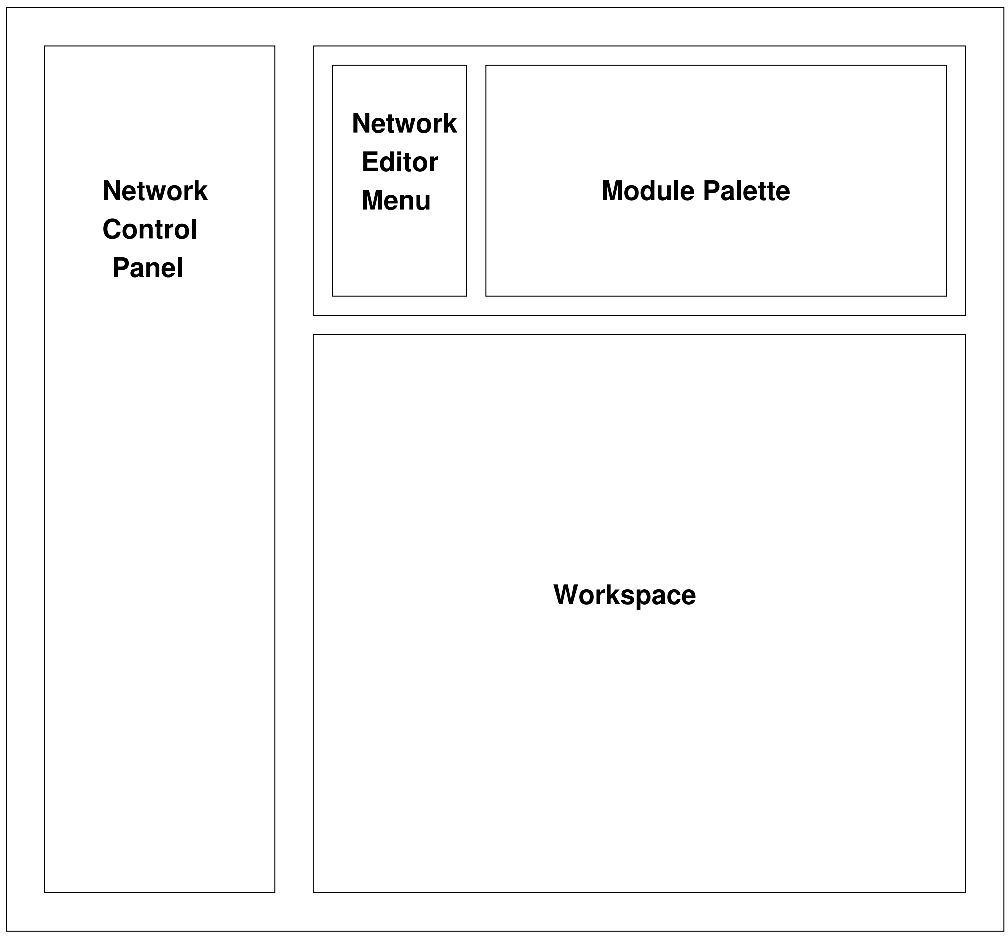
Entering the network editor



Entering the network editor

To enter the network editor simply select the panel on the AVS main menu labeled "Network Editor" by placing the cursor in the panel and pressing the left mouse button. This main menu will now disappear and the Network editor panels will be opened.

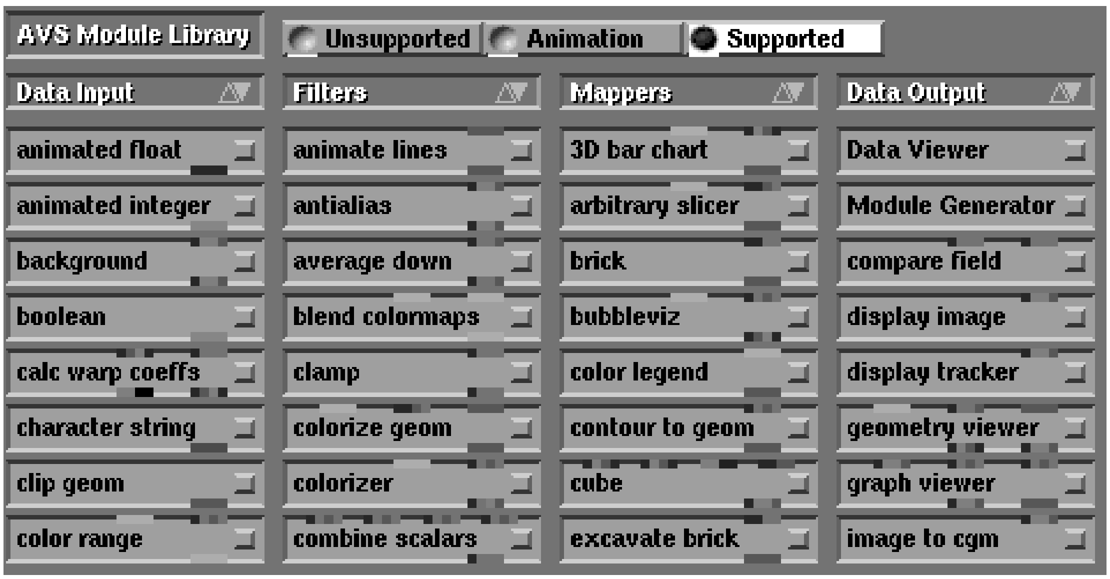
Structure of the network editor



Structure of the network editor

The diagram above shows the various areas of the network editor. The subsequent steps in the workbook will refer to these areas for guidance when selecting items.

Selecting a Module



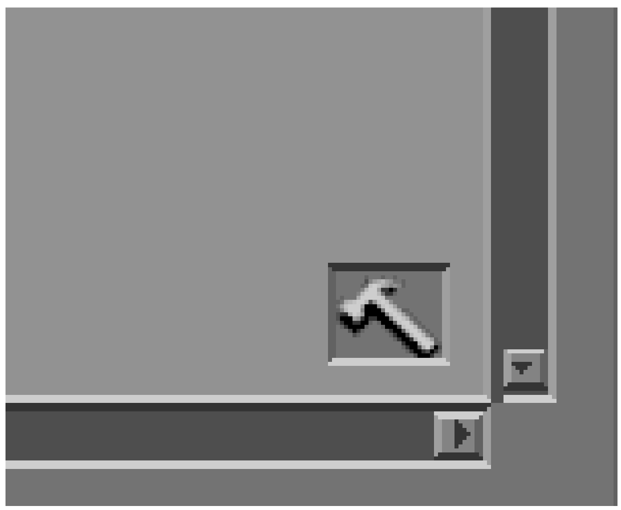
Selecting a Module

1. Find the `read_volume` module which is located in the "Data Input" column in the module palette. To find it you must scroll through the modules in that column by placing the mouse on the small arrows in the label at the top of the column labeled "Data Input". Now by clicking either the left or right mouse buttons the modules are scrolled up and down respectively.

2. Once you have located the module point to it using the mouse and press the left mouse button. While keeping the mouse button pressed simply drag the module onto the workspace. When you are happy with its location release the button and the module will be added to the workspace.

   When a module is added to the workspace notice that its associated parameter widgets are added to the "Network Control Panel".

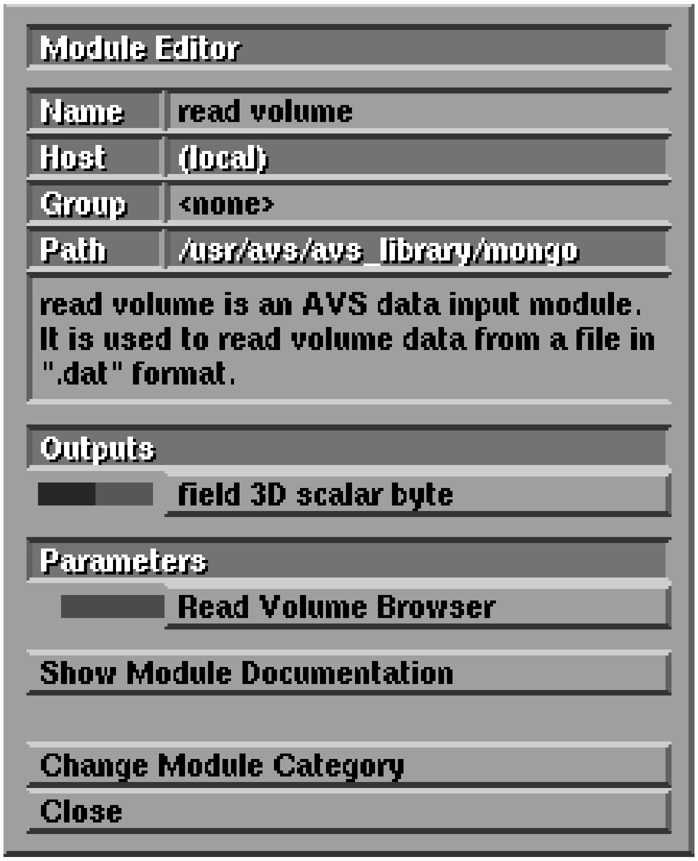
Removing a module



Removing a module

To remove a module select it with the mouse and **left** button and drag it onto the hammer icon situated in the bottom right-hand corner of the workspace area. When you release the mouse button the module is removed.

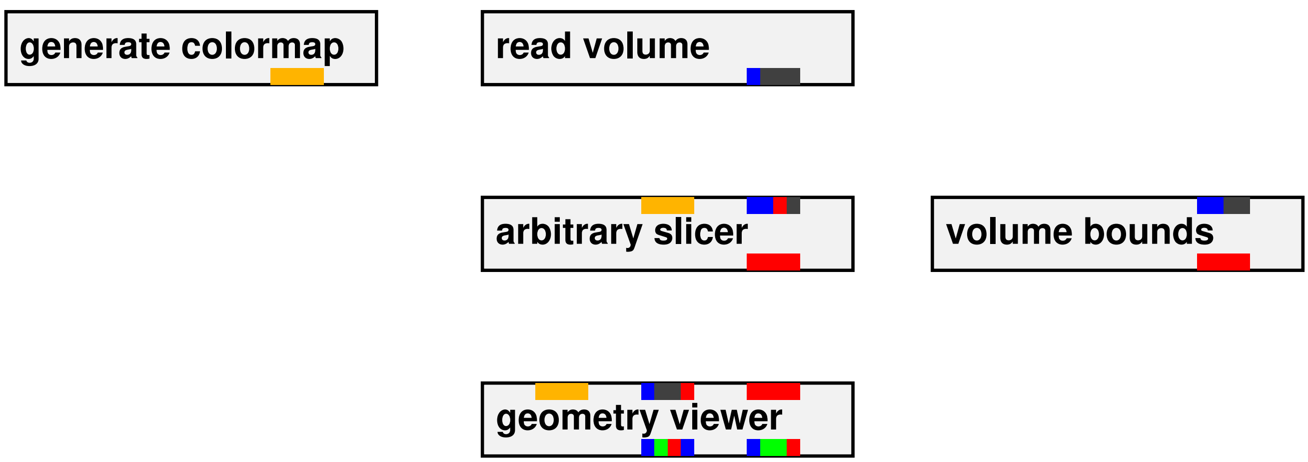
Accessing the help pages



Accessing the help pages

1. To access the help pages for a particular module simply click the dimple on the module using the mouse and the **middle** button. This will cause the brief help page to appear.
2. For more extensive help click on the button labelled "Show Module Documentation" in the brief help window which will cause the manual page for that particular module to appear.
3. To remove either of the pages click on the appropriate "Close" buttons.

Select the other modules



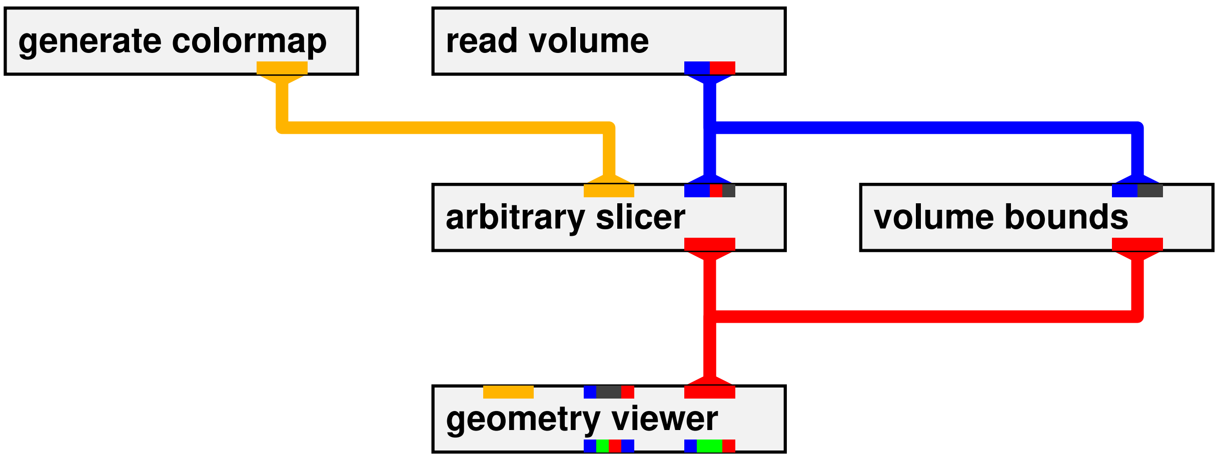
Select the other modules

1. Select the modules from the palette, to build the network above, and add them to the workspace. The modules are listed below with their location.

2. An alternative method of searching for modules is by moving the mouse into the label above the column of modules and typing the first few letters of the module's name. Try this method for the following modules.

   - `read_volume`: Data Input
   - `generate_colormap`: Data Input
   - `volume_bounds`: Mappers
   - `arbitrary_slicer`: Mappers
   - `geometry_viewer`: Data Output

Connecting the ports



Connecting the ports

Using the mouse connect the modules together to form the above network:

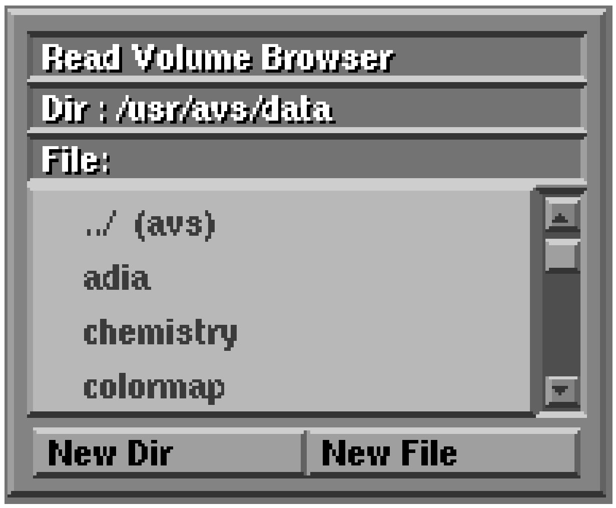
Connecting modules

To connect a modules input and output ports together move onto the port with the mouse. Now press the **middle** button and all the possible connections are shown. While keeping the button pressed move the mouse to the other module port you wish to make the connection to. The connection should now become highlighted and when you release the mouse button the connection is made.

Disconnecting modules

To disconnect a module connection move onto the module which is connected via its output port and press the **right** button while positioned on this port. While keeping this button pressed move to the other port. The connection between the two ports should now become highlighted and when the button is released this connection will be removed.

Reading a data file (1)



Reading a data file (1)

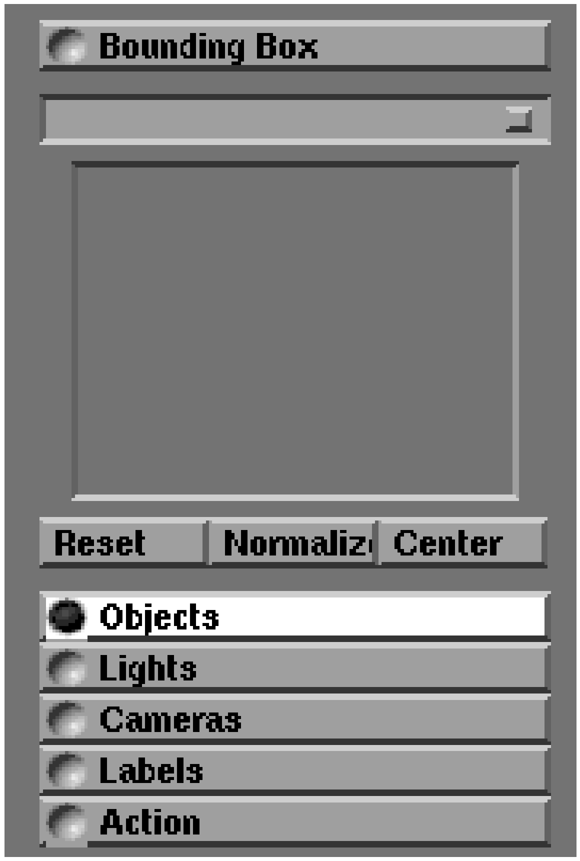
1. Select the widgets associated with the module `read_volume` by clicking on the dimple on the module with the **left** mouse button. The file browser should now appear in the "Network Control Panel".
2. Use the file browser to move to the directory `/usr/avs/data/volume` by clicking on the directory called "volume" in the file browser window. If this directory is not visible use the scrollbars at the side of the browser to find it.

Reading a data file (2)

Reading a data file (2)

Click on the file called “hydrogen.dat” in the file browser window and the network will start to execute producing a picture in the geometry viewer window.

Interacting with the objects (1)

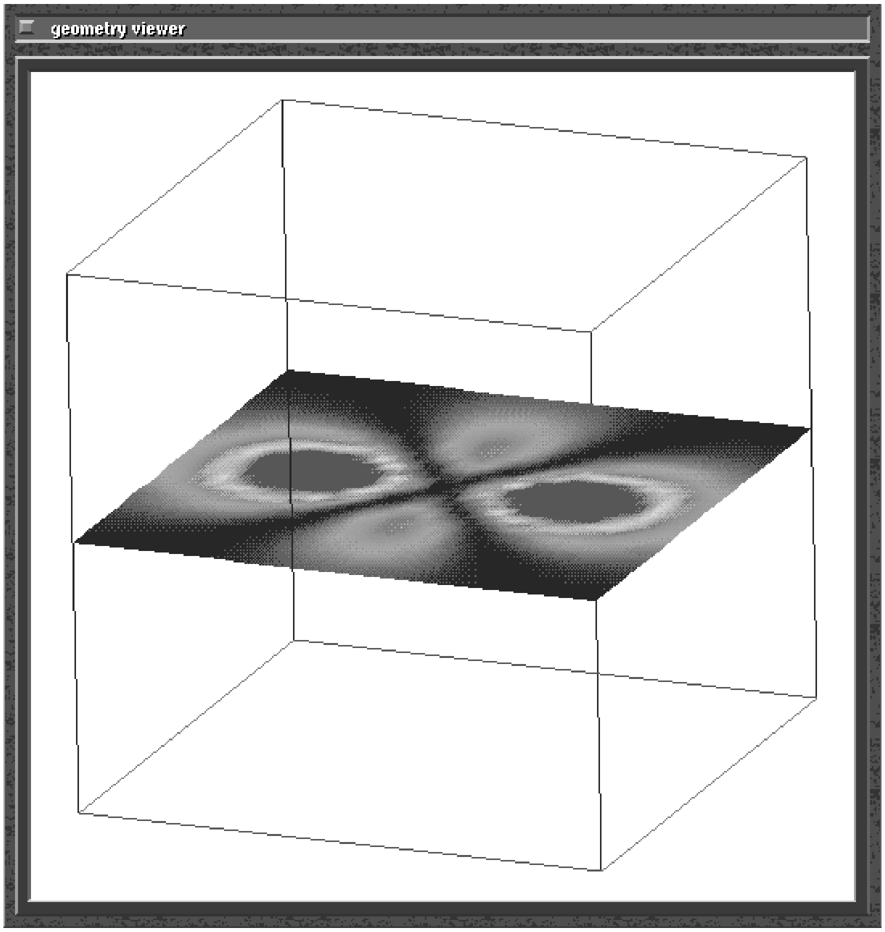


Interacting with the objects (1)

1. Click the dimple on the `geometry_viewer` module to display the associated control parameters.
2. In the network control panel click on the option "Normalise" which is the middle button under the small window in the panel.

   The full picture should now appear in the geometry viewer's window.
3. Click on the "Close" button on the top-right of the Network Control Panel window. The geometry viewer's control parameters should now disappear.

Interacting with the objects (2)



Interacting with the objects (2)

The objects in the geometry window can be manipulated using the mouse and keyboard. The following section illustrates how to perform a few simple transformations on the objects but more details can be found in the Geometry Viewer Tutorial.

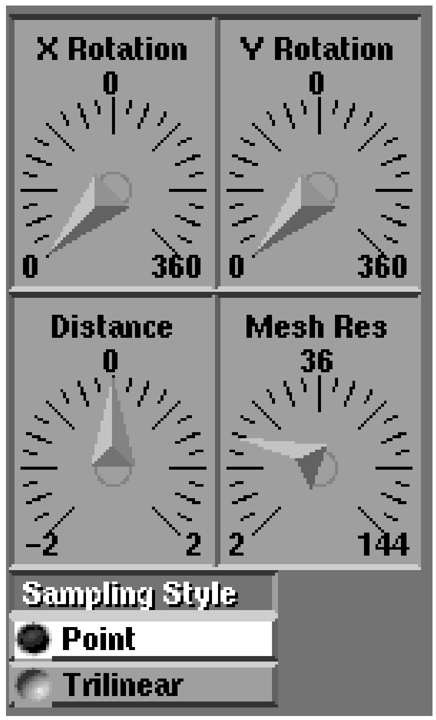
Rotating : Place the cursor in the window and while holding down the **middle** mouse button rotate the object. The manipulations are based on the virtual trackball paradigm.

Scaling : Place the cursor in the window and while holding down the `SHIFT` key on the keyboard and the **middle** mouse button move the cursor up and down to enlarge and shrink the object.

Translating : Place the cursor in the window and while holding down the `right` mouse button move the mouse to translate the object in the window.

Manipulate the object so the scene looks something like the one shown in the diagram above.

Changing the `arbitrary_slicer` parameters

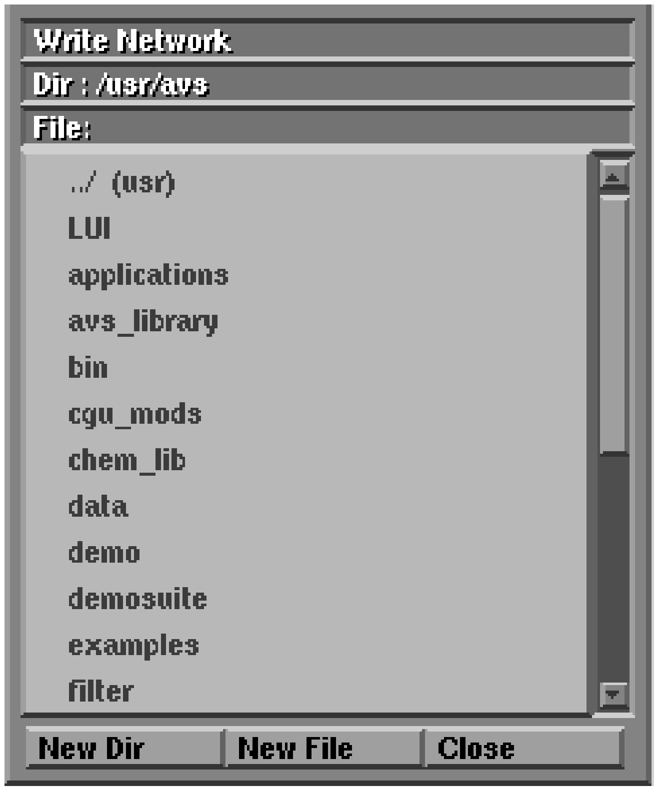


Changing the `arbitrary_slicer` parameters

1. Select the `arbitrary_slicer`'s parameters by clicking the dimple on the module with the mouse and **left** mouse button. A series of dials should appear.
2. Using the mouse position the cursor over the "Distance" dial and while holding down the **left** button change the value. The slice in the geometry viewer window should now be repositioned.

   Try altering some of the other dial parameters.

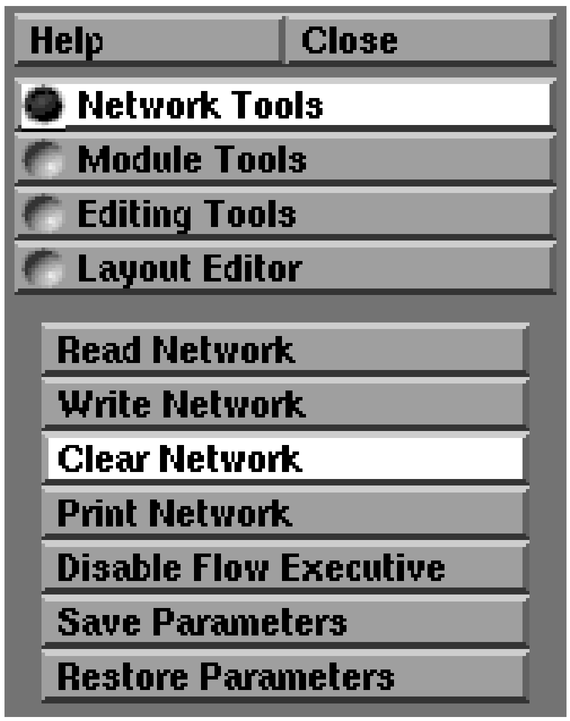
Saving networks



Saving networks

1. The network can be saved by selecting the menu button "Write Network" in the "Network Editor Menu" panel. A file browser will appear showing the files in your current working directory.
2. Change the current directory for the file browser by clicking on the "New Dir" button and type in the name of the directory you want to save the files in. Set this to your home directory if you know it or try `/tmp`.
3. Save the network in a file by clicking on the "New File" button and typing in the name of a file to save the network in. A good convention is to always use the file extension `.net`, e.g., `fred.net`.

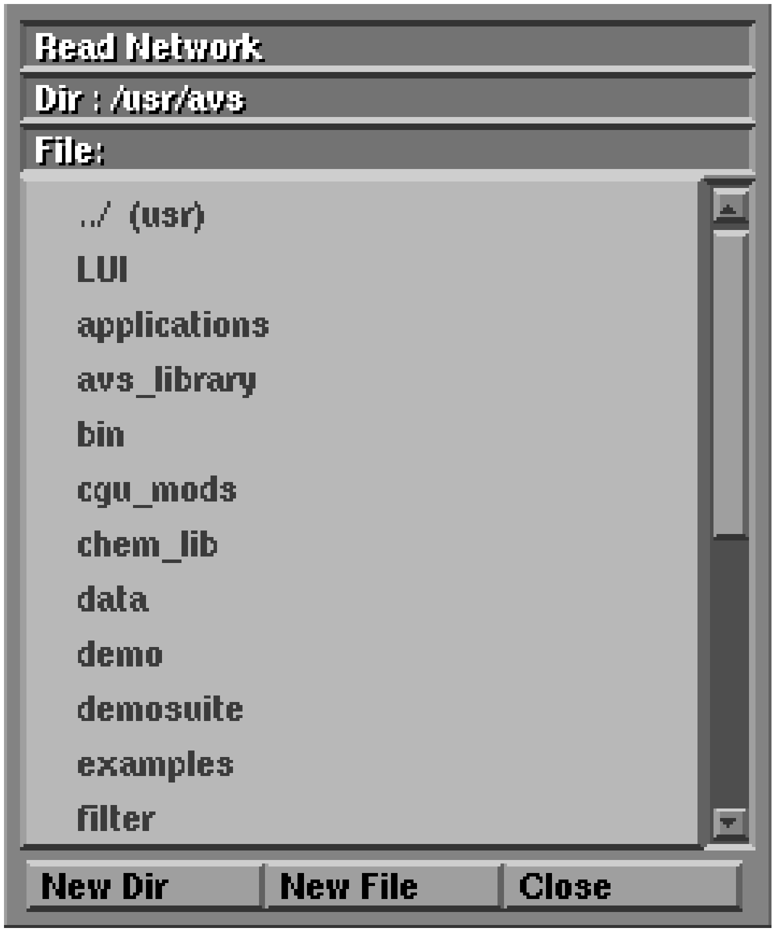
Clearing the network editor



Clearing the network editor

1. To clear an already existing network from the workspace select the option “Clear Network” from the Network Editor Menu panel.
2. You are then asked to confirm this. Select “Ok” if you wish to proceed.

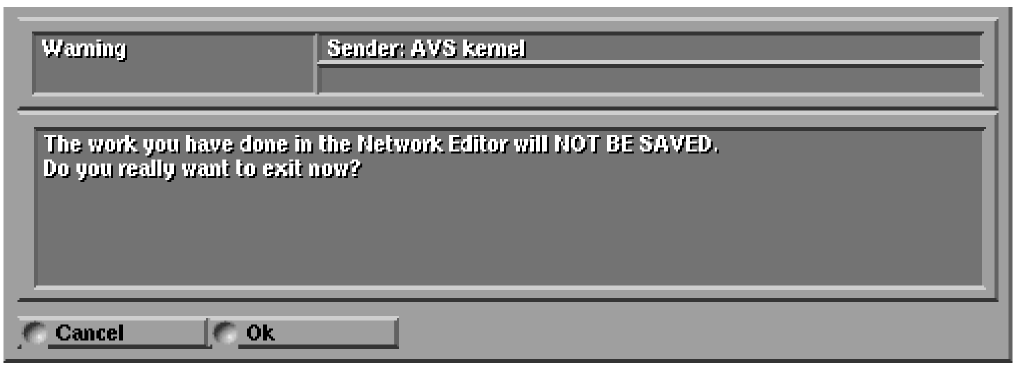
Reading networks



Reading networks

1. To read a network select the "Read Network" button on the "Network Editor Menu" panel. A file browser will appear showing the files in your current working directory.
2. Change the current directory for the file browser by clicking on the "New Dir" button and type in the name of the directory you want to save the files in.
3. To read a network simply click on the file name in the file browser window.

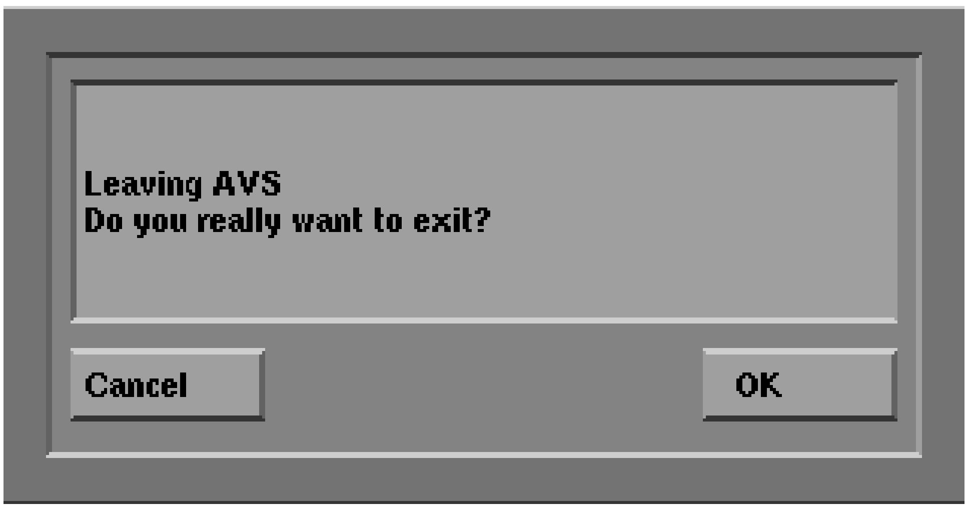
Exiting from the network editor



Exiting from the network editor

1. To exit from the network editor click the button labelled “Exit” at the top of the “Network Control Panel”.
2. You will then be asked “Are you sure ?” in a pop-up window. Click the “Ok” button if you still wish to exit. The network editor panels will disappear and the AVS main menu will reappear.

Exiting from AVS



Exiting from AVS

1. To exit from AVS click the button labelled "Exit AVS" on the AVS main menu.
2. You will then be asked "Are you sure ?" in a pop-up window. Click the "Ok" button if you still wish to exit.

3 Visualising 2D arrays of data

Description of the Data

The aim of this exercise is to import and process the following two datasets:

mri.dat : This data file represents a MRI scan of the brain. The dataset is 2D and contains 512×512 single scalar bytes for each data value. The data file is binary and the data is arranged contiguously with no header information.

hslice.dat : This data file represents a single slice through a hydrogen molecule where the data values represent the electron density. The dataset is 2D and contains 64×64 single scalar bytes for each data value. The data file is binary and the data is arranged contiguously with no header information.

temps.dat : This data file represents temperatures taken from a cross section of an injection moulding system. The ASCII data file contains data on a regular, 31×31 grid. The data component at each element is a single floating point value and the first two numbers in the file indicate the X and Y dimensions of the grid respectively.

Starting AVS

By default when you first instance a version of the `read_field` module, and any other module which reads data, it will point to the directory `/usr/avs/data`. In this exercise you will want to read the files `mri.fld`, `temps.fld` and `hslice.fld` which you are about to create in your home directory. To remove the need to keep changing directory each time you use `read_field` you can change the default data directory by typing the following commands to place you in your home directory and start avs:

```
cd
avs -data `pwd`
```

Please note that the command `pwd` is surrounded by back-quotes ‘ as opposed to the useful quote character ’.

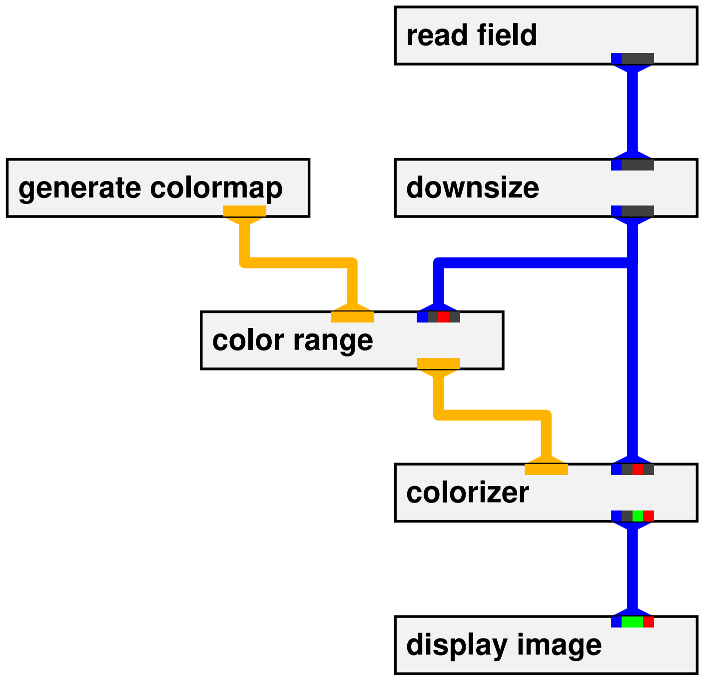
Importing the `mri.dat` data

```
# AVS field file
#
ndim = ?
dim1 = ???
dim2 = ???
nspace = ???
veclen = ???
data   = ???
field  = ???
variable 1 file=/usr/avs/auxdata/mri.dat filetype=??? skip=??? stride=???
```

Importing the `mri.dat` data

- Create a file called `mri.fld` to describe the data contained in `mri.dat`.
- Use the template description above and the information at the start of this chapter, describing the `mri.dat` data, to complete the specification.

Displaying the MRI data

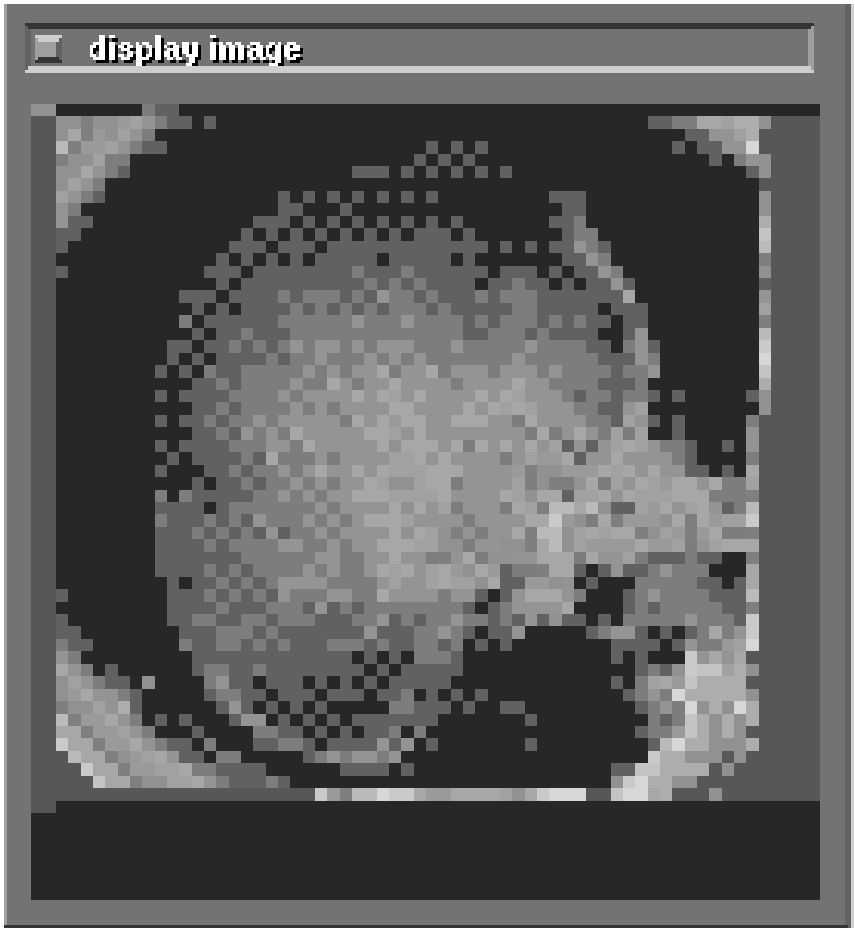


Displaying the MRI data

Using the network editor construct the above network. The location of the modules are listed below:

- `read_field`: Data Input
- `generate_colormap`: Data Input
- `color_range`: Data Input
- `downsize`: Filters
- `colorizer`: Filters
- `display_image`: Data output

Importing the `mri.dat` data (2)



Importing the `mri.dat` data (2)

1. To import the data into the network select the file **`mri.fld`** you have just created using the **`read_field`** file browser. If a picture similar to the one above appears then you have been successful.

2. If you are having difficulties try connecting the module **`print_field`** (Data Output) to the **`read_field`** module to analyse the field data which is being imported.

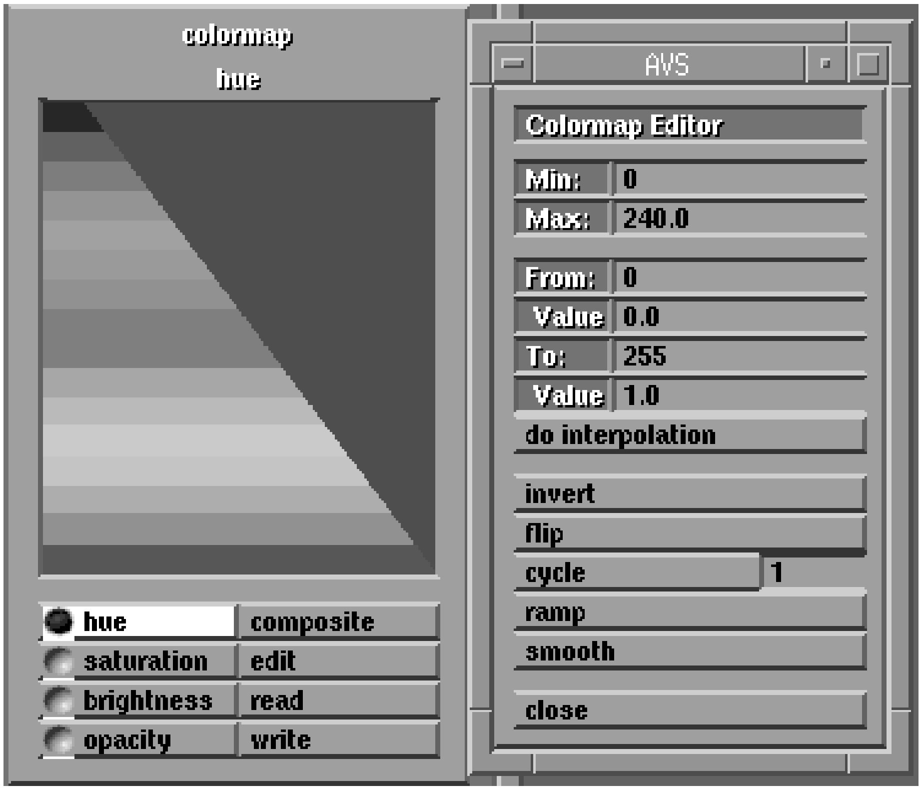
Changing the downsizing

Changing the downsizing

The image displayed will have been produced by a subset of the data as the `downsize` module subsamples the imported data.

1. Select the `downsize` parameters and change the value to see what happens.
2. If the image is larger than the screen select the option "1x" from the `display_image` sub-menu. This sub-menu is accessed by pressing the left mouse button while pointing at the dimple on the top-left corner of the `display_image` window.

Changing the colour map



Changing the colour map

The image is coloured using the colourmap produced from the `generate_colormap` module. The next steps will change it into a greyscale colourmap.

1. Select the parameters associated with the module `generate_colormap`.
2. Click on the button labelled "saturation" on the colormap parameters followed by the button labelled "edit". A small colormap editor window will be opened.
3. In the colormap editor window change the value in the box labelled "Value", under the box labelled "To:", to 0.0. Press the button "do interpolation" to change the saturation values.
4. Select the "close" button on the Colormap Editor window.
5. Click on the button labelled "brightness" on the colormap parameters followed by the button labelled "edit". A small colormap editor window will be opened.
6. In the colormap editor window the value in the box labelled "Value", under the box labelled "To:", is already set to 1.0. Press the button "do interpolation" to change the saturation values.
7. Select the "close" button on the Colormap Editor window.

The original image should now be a greyscale image shown on the following page.

Final greyscale image

Final greyscale image

Try altering the parameters on the colourmap to produce a binary (black and white) image instead of the greyscale image.

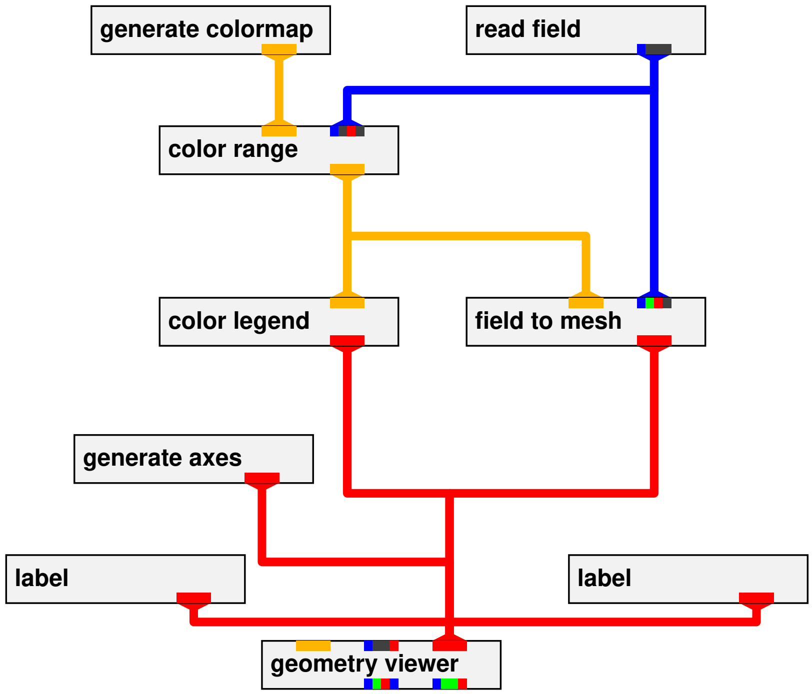
Importing the `temps.dat` data

```
# AVS field file
#
ndim = ?
dim1 = ???
dim2 = ???
nspace = ???
veclen = ???
data   = ???
field  = ???
variable 1 file=/usr/avs/auxdata/temps.dat filetype=??? skip=??? stride=???
```

Importing the `temps.dat` data

- Create a file called `temps.fld` to describe the data contained in `temps.dat`. N.B., because the two data files are similar you should copy `mri.fld` to `temps.fld`.
- Use the template description above and the information at the start of this chapter, describing the `temps.dat` data, to complete the specification.

Displaying the temperature data with `field_to_mesh`

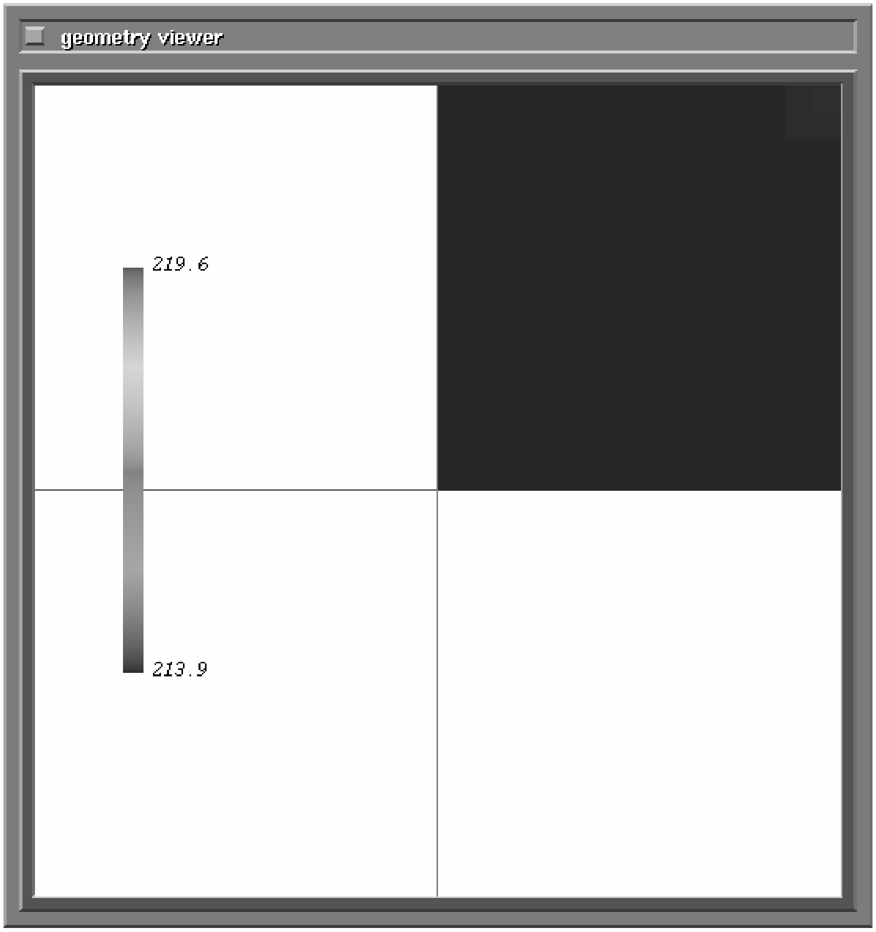


Displaying the temperature data with `field_to_mesh`

Using the network editor construct the above network. The location of the modules are listed below:

- `read_field`: Data Input
- `generate_colormap`: Data Input
- `color_range`: Data Input
- `color_legend`: Mappers
- `field_to_mesh`: Mappers
- `label`: Data Input
- `generate_axes`: Data Input
- `geometry_viewer`: Data Output

Importing the `temps.dat` data (2)

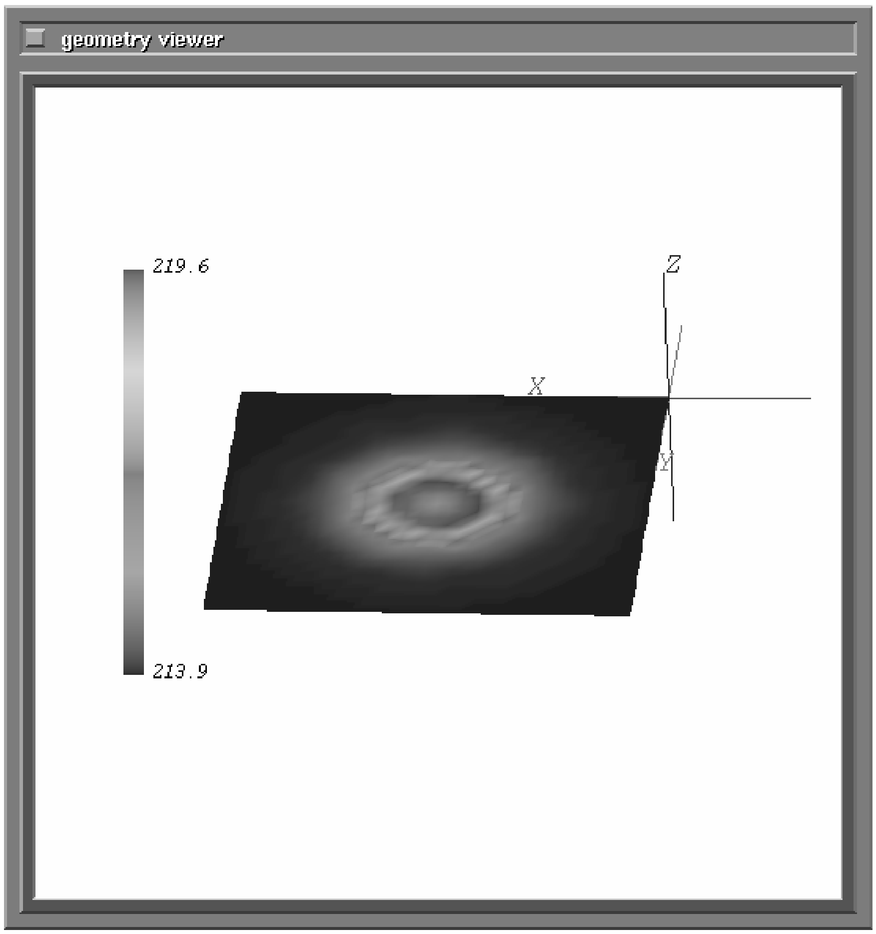


Importing the `temps.dat` data (2)

1. To import the data into the network select the file `temps.fld` you have just created using the `read_field` file browser. If a picture similar to the one above appears then you have been successful. The colour bar is the product of the `color_legend` module, the axes of `generate_axes` and the object of `field_to_mesh`.

2. If you are having difficulties try connecting the module `print_field` (Data Output) to the `read_field` module to analyse the field data which is being imported.

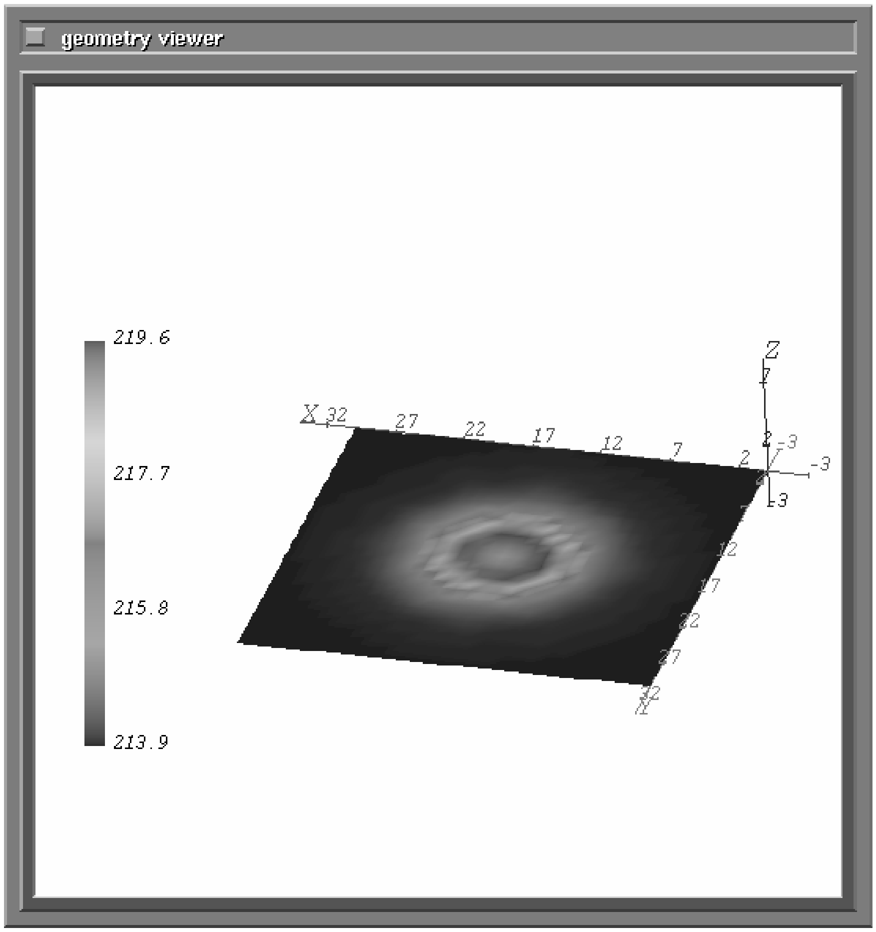
Normalizing the picture



Normalizing the picture

Select the geometry_viewer parameters to normalize the picture so you can fit the whole object in the window. Now using the mouse, transform the object so it appears as above. It may be helpful to select the bounding box option which is a geometry_viewer parameter to aid the transformation.

Altering `color_legend` and `generate_axes`

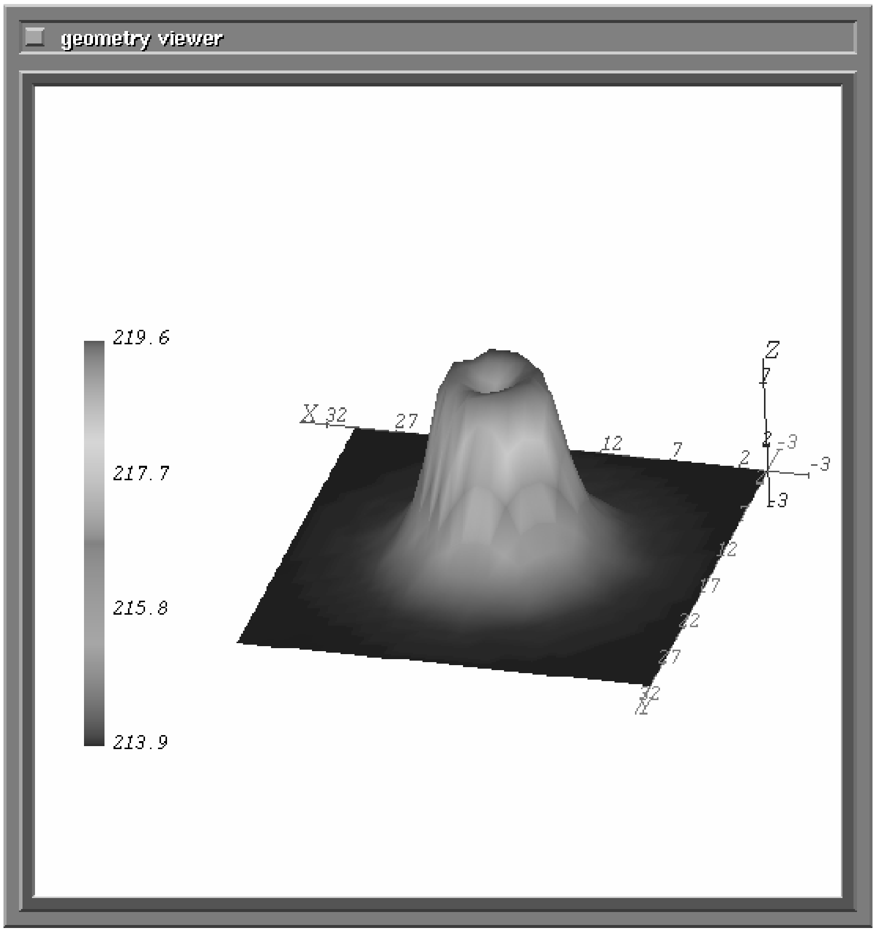


Altering `color_legend` and `generate_axes`

Select the `color_legend` parameters and reposition the colour bar or legend using the X and Y position settings. Change the font and number of tics.

Change the parameters of `generate_axes` to move the origin and length of the axes.

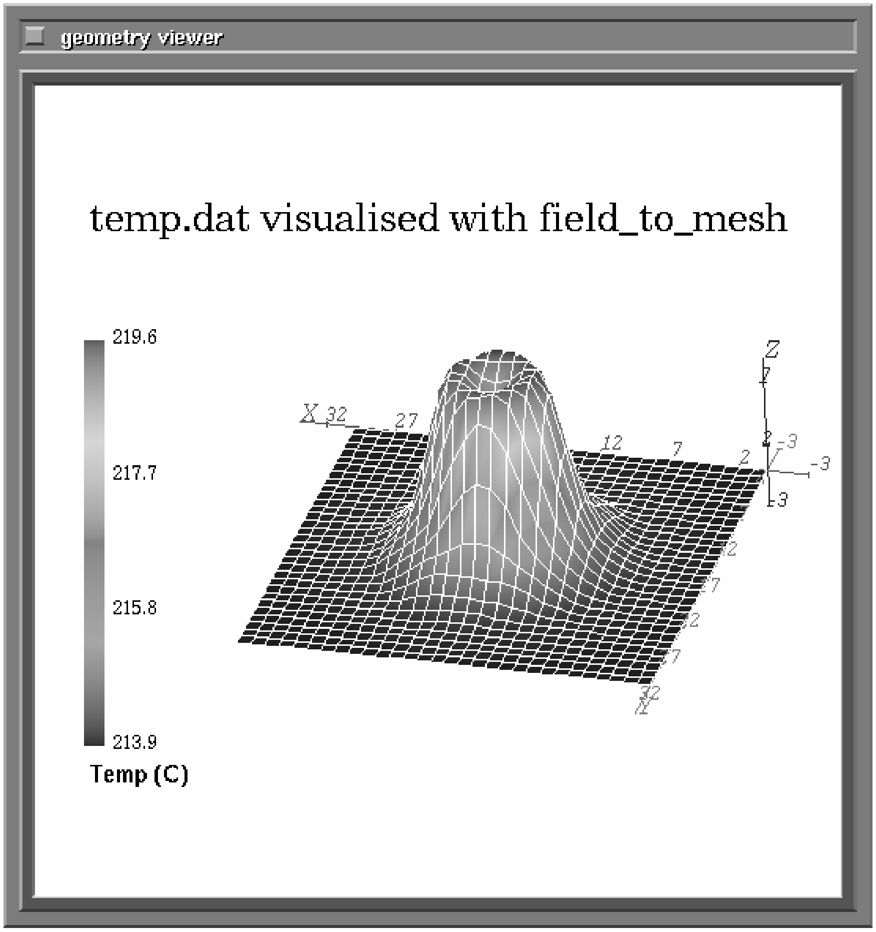
Using `field_to_mesh`



Using `field_to_mesh`

Select the **`field_to_mesh`** parameters and alter the dial to increase the Z Scaling. The module should now produce a picture as shown above.

Enhancing the picture

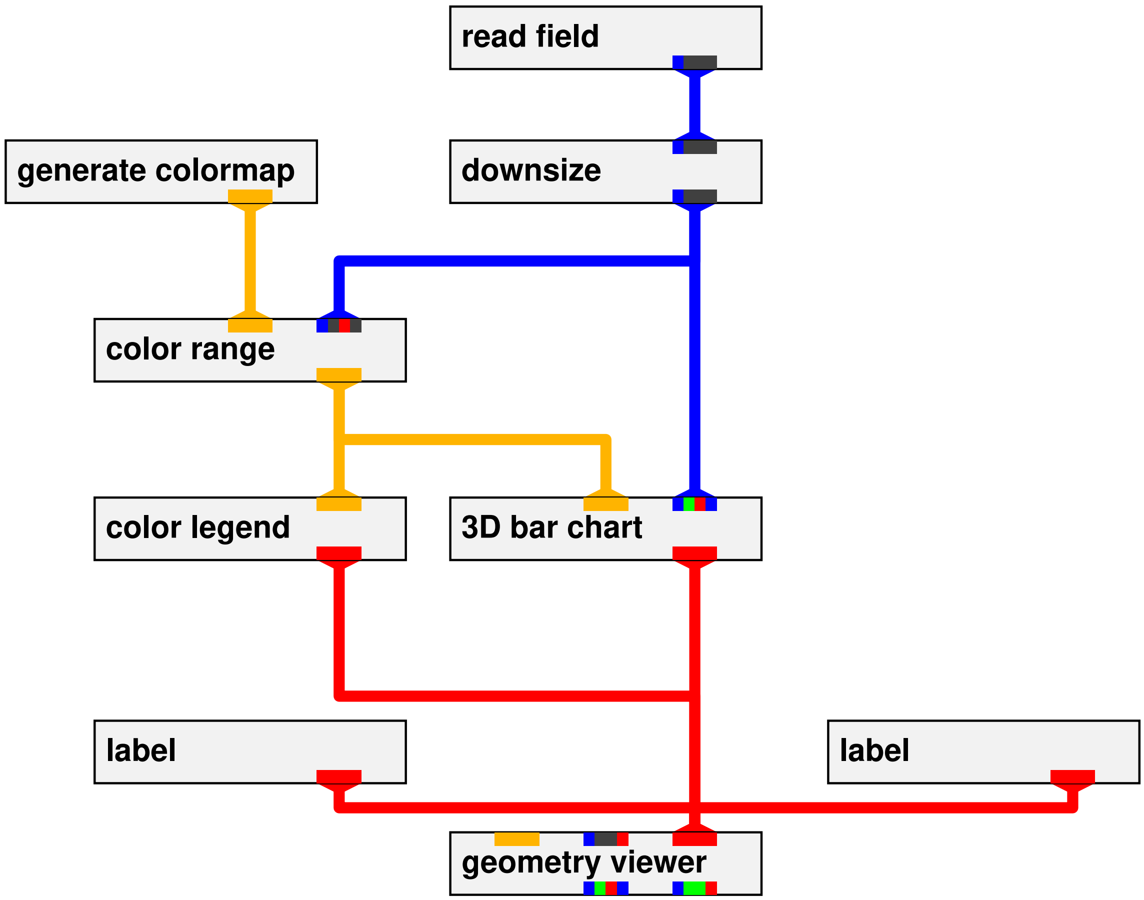


Enhancing the picture

Select the geometry_viewer parameters and from this select outline gouraud which can be found towards the bottom of the panel. This shades the image and superimpose a wireframe image on the `field_to_mesh` image.

To write the two labels and place on the picture. Select the `label` parameters and in the title string box enter the text, also change the font number and position variables.

Displaying the temperature data with `3D_bar_chart`

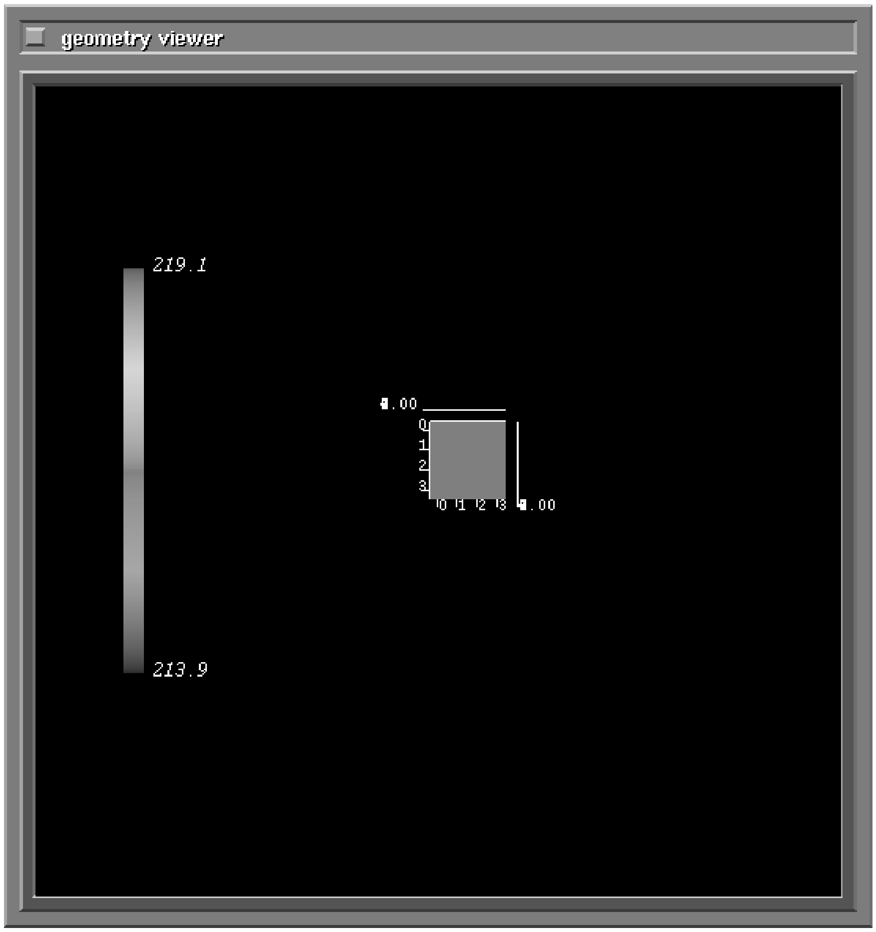


Displaying the temperature data with `3D_bar_chart`

Using the network editor construct the above network. The location of the modules are listed below:

- `read_field`: Data Input
- `downsize`: Filters
- `generate_colormap`: Data Input
- `color_range`: Data Input
- `3D_bar_chart`: Mappers
- `color_legend`: Mappers
- `label`: Data Input
- `geometry_viewer`: Data Output

Importing the `temp.dat` data

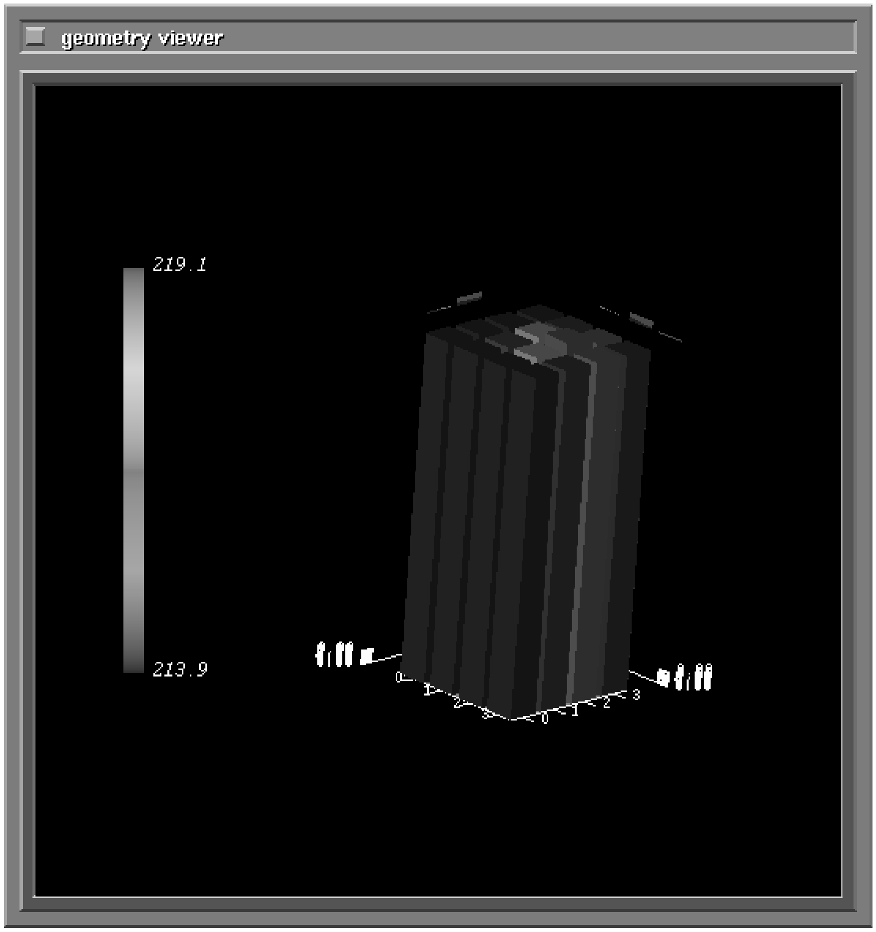


Importing the `temp.dat` data

1. To import the data into the network select the file **`temps.fld`** you have just created using the **`read_field`** file browser. If a picture similar to the one above appears then you have been successful. The color bar is a product of **`color_legend`**, and the object of **`3D_bar_chart`**.

2. If you are having difficulties try connecting the module **`print_field`** (Data Output) to the **`read_field`** module to analyse the field data which is being imported.

Normalizing the picture



Normalizing the picture

Use the mouse to rotate the bar chart and enlarge. It may be helpful to select the bounding box option which is a geometry_viewer parameter to aid the transformation.

To reduce the bar chart's length select the `3D_bar_chart` parameters. Change the Z scale value by clicking on the dial's middle circle and then alter the 'Value' from 1 to 0.01.